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GB 403914
(58) Field of search F1F
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(54) **Rotary Positive-Displacement Fluid-Machines**

(57) A machine that may be an I.C. engine or a pump has a spherical chamber *a* containing both a squat cylindrical rotor *b* with a shaft *e* and an oblique revolving plate *f*. The rotor and the plate are interconnected by sliding blocks *k*. Working-fluid ports *s*, *r* communicate with the spaces between the rotor and the plate, the volumes of these spaces varying owing to the mutual inclination of the rotation axes HL, PL of the rotor and the plate.

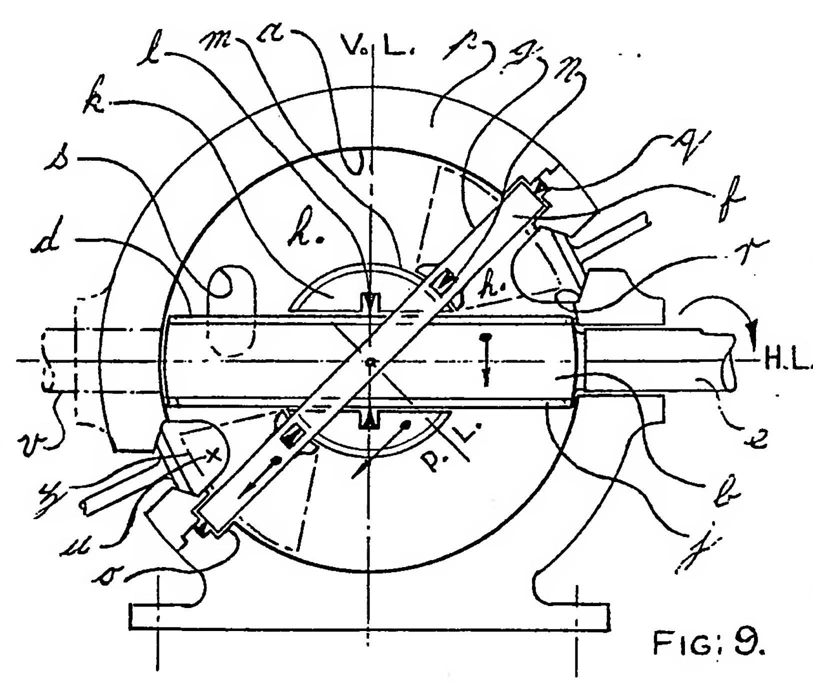

FIG: 9.

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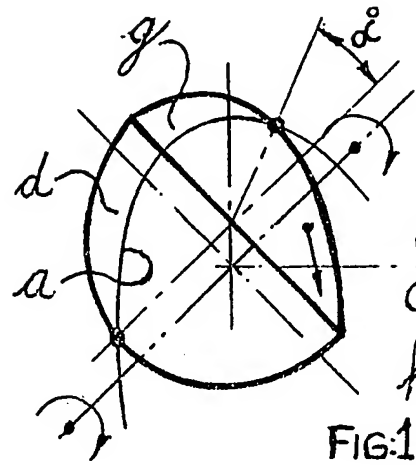


FIG:1V.

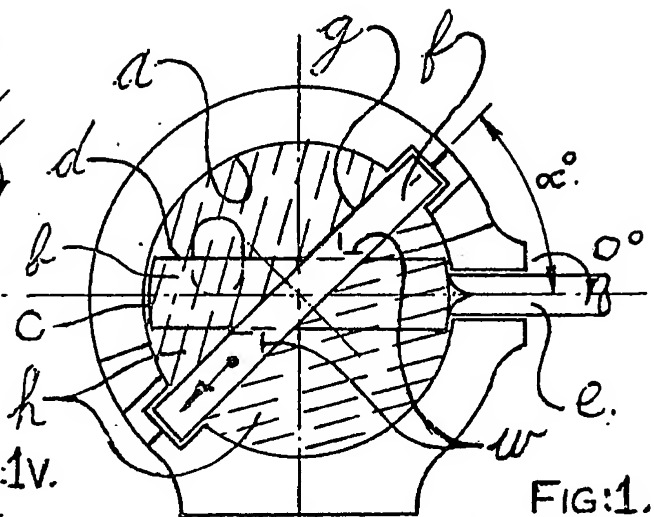


FIG:1.

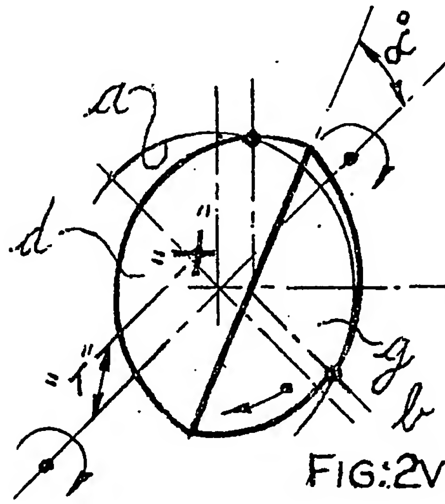


FIG:2V.

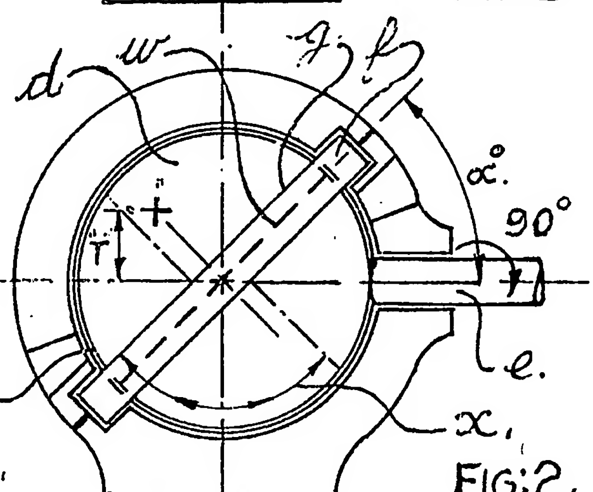


FIG:2.

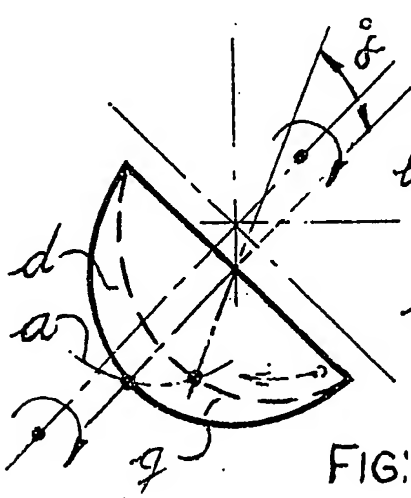


FIG:3V.

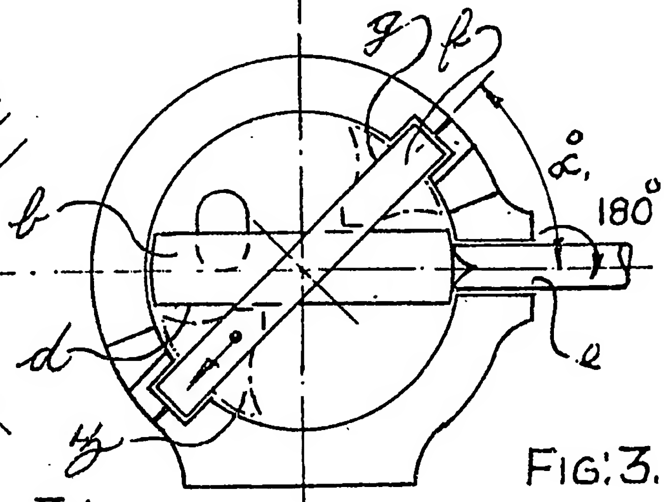
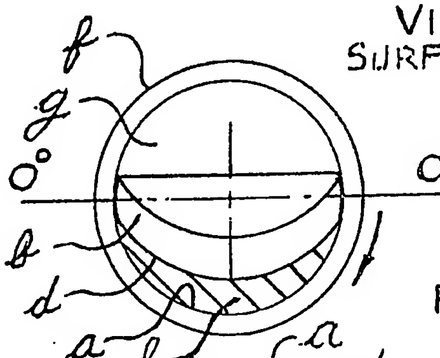


FIG:3.

P.O.
ORIGINAL.

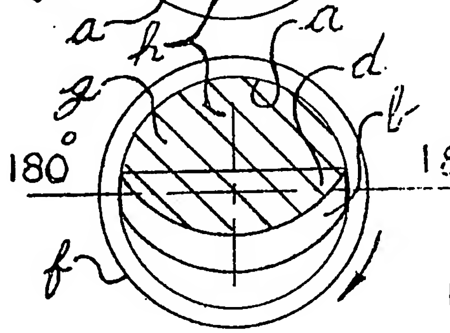
D.I.MITCHELL. 22185 2052639 3·SHEETS SHEET·2.

WORKING CHAMBER:-
VIEWS LOOKING ON
SURFACE "g" OF ROTATING PLATE "f".



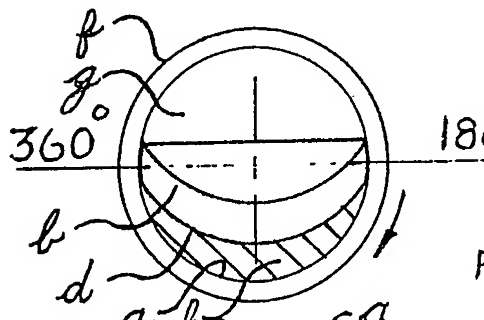
0° STARTING POSITION.
BEGINING "INDUCTION."

FIG: 4.



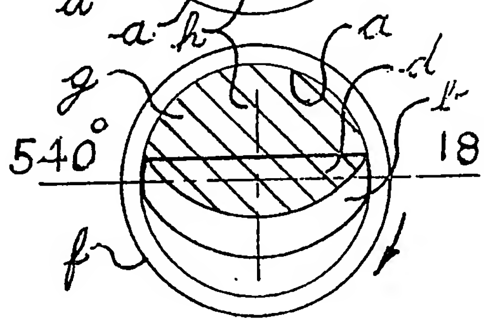
180° MAXIMUM "INDUCTION."
BEGINING "COMPRESION."

FIG: 5.



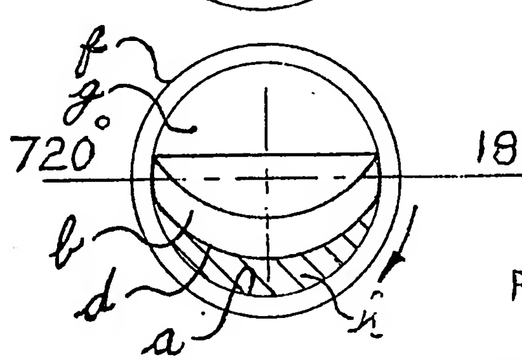
180° MINIMUM "COMPRESION."
BEGINING "POWER."

FIG: 6.



180° MAXIMUM "POWER"
BEGINING "SCAVANGING"

FIG: 7.



180° MINIMUM "SCAVANGING."
BEGINING "INDUCTION."

FIG: 8.

P.O.
ORIGINAL

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22135

3 SHEETS.
SHEET-3.

2052639

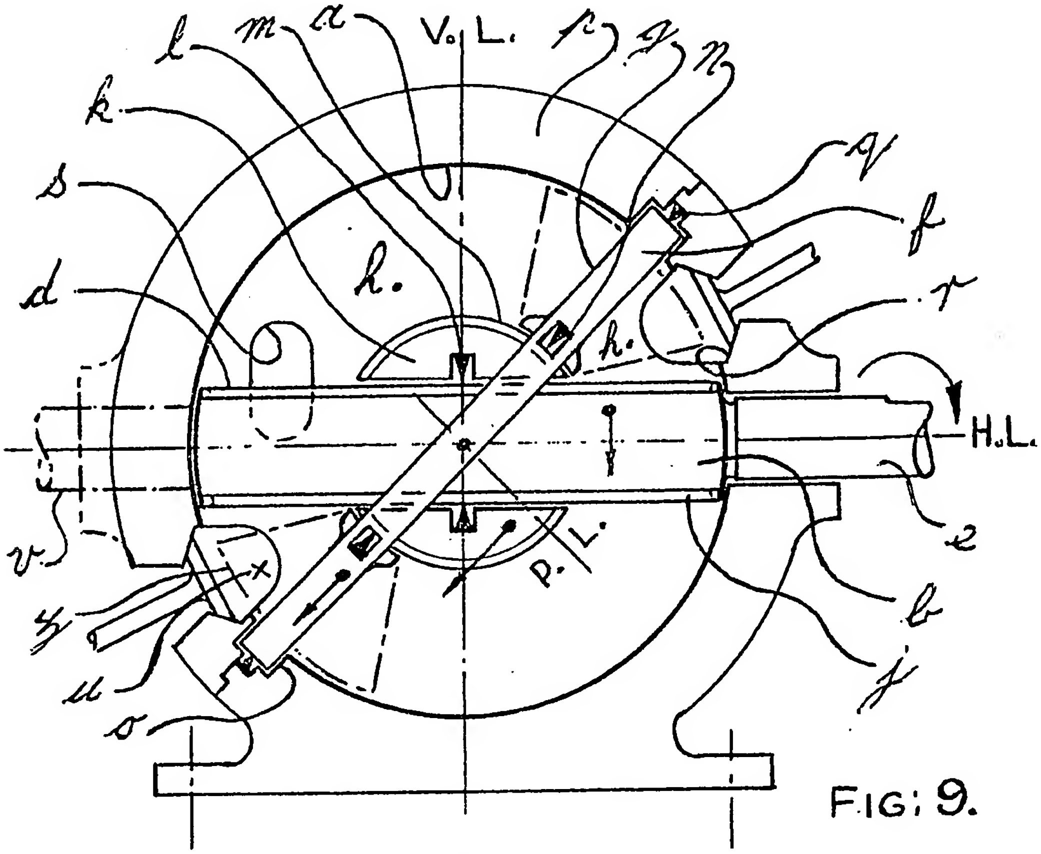

FIG: 9.

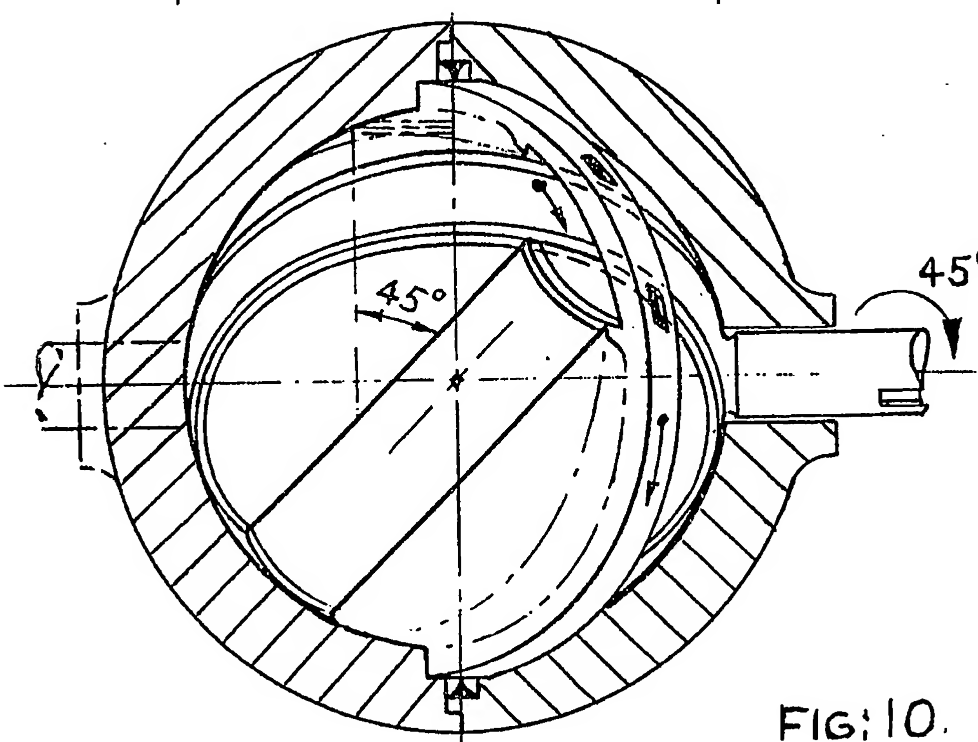

FIG: 10.

SPECIFICATION
Spherical Rotary Piston Machine Generating Variable Volumes

The invention relates to a rotary machine, generating variable volumes, and its mode of operation.

According to the present invention, I provide a "Spherical" rotary machine assembly, including, a mainly longitudinally rotating mainly squat cylindrical rotor and its integral shaft; the said rotor inserted through a angular dispositioned mainly axially synchronously rotating plate; their junction geometrically relatively universally part-rotary fit; all housed within and rotating concentrically with the mainly longitudinal axis of a spherical chamber. The whole being optionally complimented by suitable sealing, inlet-exhaust porting, valving, etc.

The formation of the variable individual volumes results from the individual surfaces of mainly longitudinally rotating squat cylindrical rotor relative to the cyclicly continuously varying angle individual surfaces of angular dispositioned mainly axially synchronously rotating plate; both revolving within their own plane, axis concentric with the mainly longitudinal axis of their housing spherical chamber.

The present invention will now be described in greater detail by way of example only; with reference to the accompanying drawings, Sheet 1, Sheet 2, and Sheet 3, wherein:—

Figure 1, is a diagram illustrating the arrangement of the squat cylindrical rotor with integral shaft, relative to the rotating plate, (in this selected instance one piece), housed within a ported spherical chamber. The two sets of "cross-hatching" indicating individual "Working-chambers" of two "Individual" chambers each.

Figure 1v. is a diagram illustrating the maximum volume of the squat cylindrical rotor face, relative to rotating plate face, when positioned as in Figure 1, within an individual chamber.

Figure 2. is a diagram illustrating a 90° rotation of the squat cylindrical rotor, and synchronised rotation of the rotating plate, with proportion of surface of squat cylindrical rotor swept by "relative movement" of rotating plate. The "Centre of Pressure" on the face of the squat cylindrical rotor relative to axis of rotation. Angle $\alpha°$ determines distance of "centre of pressure" and proportion of effective pressure, from axis of rotation of squat cylindrical rotor.

Figure 2v. is a diagram illustrating the intermediate volume of the squat cylindrical rotor face relative to the rotating plate face, when positioned as in Figure 2.

Figure 3 is a diagram illustrating a 180° rotation of the squat cylindrical rotor, and synchronised rotation of the rotating plate. Indicating an excresance thereon.

Figure 3v. is a diagram illustrating the minimum volume of the squat cylindrical rotor face relative to the face of the rotating plate, when positioned as in Figure 3. Angle $\alpha°$ determining minimum volume.

Figures 4, 5, 6, 7, 8. are sequenced diagrams illustrating views on surface of rotating plate and surface of squat cylindrical rotor at various angular positions, cyclicly varying individual chamber volumes obtained, related to "Four-stroke" principle.

Figure 9 is a diagram illustrating a part-transverse section of an example application of the principle to a form of "Internal-Combustion-Engine." (Alternatively, as drawn, can be applied as an "Integral Engine Pump.")

Figure 10 is a diagram illustrating a part-transverse plan section of Figure 9. The squat cylindrical rotor with rotating plate rotated through an example 45° rotation.

The principle is illustrated diagramatically in Figures: 1, 1v; 2, 2v; 3, 3v; and 4, 5, 6, 7, 8.

To consider Figure 1, where the curve "a" representing the internal contour of a spherical chamber; in which is inserted a squat cylindrical rotor "b", with its edge surface "c" contoured to sliding-fit spherical chamber contour "a"; and two bearing surfaces "d" combining bearing and pressure loads, selected in this instance as two flat parallel surfaces denoted "d"; its integral shaft "e" locating its longitudinal position. Fitting over squat cylindrical rotor "b", and making a relative "axially universally part-rotary" sliding-fit, its surfaces "w" always in contact with squat cylindrical rotor surfaces "d"; and with pressure surfaces "g" is selected one piece rotating plate "f", which also rotates in spherical chamber "a" at angle $\alpha°$. The surfaces "g" of rotating plate "f" and surface "d" of squat cylindrical rotor "b", in conjunction with spherical chamber surface "a", forming an "Individual Chamber" "h". Surface "g" of rotating plate "f" relative to surface "d" of squat cylindrical rotor "b", forming a maximum induced volume; this volume illustrated in Figure 1v.

Figure 2. illustrating a 90° rotation of squat cylindrical rotor "b" and its integral shaft "e", and corresponding 90° rotation of rotating plate "f"; and the relative "axially universally part-rotary" sliding on surface "d" of squat cylindrical rotor "b", of surface "w" of rotating plate "f", indicated by dimension line "x". As drawn, the position of surface "d" of squat cylindrical rotor "b" relative to surface "g" of rotating plate "f" forming a cyclicly smaller intermediate volume (compared to Figure 1), as illustrated in Figure 2v. The surface "d" of squat cylindrical rotor "b", limited by surface "w" of rotating plate "f", forms a variable positioned area, whose "Centre of Area" or "Centre of Pressure" denoted by symbol "X" at distance "T" from axis of rotation. Angle $\alpha°$ locating axial rotating position of rotating plate "f", determines dimension "T" relative to squat cylindrical rotor "b" axis of rotation; and also determines "Ratio" of pressure acting as a "Torque" on surface "d" of squat cylindrical rotor "b", by pressure, acting proportionately at "T" on each side of squat cylindrical rotor "b" axis of

rotation; and also determines "Compression Ratio".

Figure 3 illustrating a 180° rotation of squat cylindrical rotor "b", and its integral shaft "e"; and corresponding 180° rotation of rotating plate "f". This further rotation is compared to Figure 2, when 90° rotation of squat cylindrical rotor "b" cyclicly compresses volume described in Figure 2. and Figure 2v; thus surface "d" of squat cylindrical rotor "b" is rotating through 90° whilst relative "axially universally part-rotary" sliding fit in rotating plate "f" which is also rotating through 90°. This relative movement of surface "d" of squate cylindrical rotor "b" to surface "g" of rotating plate "f" produces a constantly cyclic varying reducion in volume, until at position illustrated (i.e. 180° rotation) the minimum volume is obtained. Figure 3v. illustrating the minimum volume determined in Figure 3. Further reduced by indicated excresance "z".

Further rotation of squat cylindrical rotor "b", with corresponding rotation of rotating plate "f", cyclicly enlarged minimum volume of Figure 3, to conditions applicable to Figure 2. The varying pressure on surface "d" of squat cylindrical rotor "b", and varying distance "T" of "Centre of Pressure" symbol "X" relative to axis of rotation, produces a turning torque obtained from integral shaft "e".

To apply this principle, for example to the basic requirement of an "Internal Combustion Engine", as demonstrated in Figure 9., which is in substance a reproduction of Figure 1.; drawn at start of induction of "fuel-mixture", and read in conjunction with Figures 4, 5, 6, 7, 8.

Figure 9 is a diagram illustrating a form of construction of the invention and a method of sealing. In this example, the invention is applied in the form of an "Internal Combustion Engine". In this instance a squat cylindrical rotor "b" with circular seals "j" and integral shaft "e"; the squat cylindrical rotor "b" inserted between sliding blocks "k", with seals "l", axially relative part-rotating on surfaces "d" of squat cylindrical rotor "b". The sliding blocks "k" are located in a fitted slot with seals "n", within rotating plate "f", sliding longitudinally on curved surface "m" of sliding block "k". This selected arrangement gives squat cylindrical rotor "b", relative to rotating plate "f", gas tight sealing; when sealing is universally partrotating about horizontal centre line "H.L.", vertical centre line "V.L.", rotating plate "f" centre line "P.L.". The rotating plate "f" rotating in conjunction with squat cylindrical rotor "b"; and located in groove "o" within spherical chamber "a" casing "p", and sealed by circular seals "q". A working chamber of two individual chambers "h" are ported by exhaust ports "r" and inlet ports "s" (bottom individual chambers "h", inlet port "s" not shown.) The ports being positioned relative to rotating squat cylindrical rotor "b".

The cycle of "Induction-Compression-Power-Exhaust", within the individual chamber "h", as illustrated in Figures 4, 5, 6, 7, 8, can be obtained by rotating squat cylindrical rotor "b" from its drawn position of Figure 9 (Figure 4) in direction of rotation shown. The inlet port "s" being open inducing fuel-mixture, until at maximum volume inlet ports "s" closes when squat cylindrical rotor "b" rotates to 180°. (Figure 5) Position. The squat cylindrical rotor "b" further rotates through 180° (Figure 6, 360°) to position as drawn in Figure 9. The obtained maximum volume of induced fuel-mixture being compressed between surfaces "m" of sliding block "k" with surface "g" of rotating plate "f"; and surface "d" of squat cylindrical rotor "b", where mixture is compressed into minimum volume "u" adjacent to closed exhaust port "r". At this stage compressed fuel-mixture is ignited, applying torque to squat cylindrical rotor "b" until at position 180° (Figure 7, 540°) exhaust valve "r" is open, while further rotation of 180° (Figure 8, 720°) squat cylindrical rotor "b" scavnges, and is again positioned as drawn in Figure 9 (Figure 4).

By positioning inlet/exhaust porting, and inlet/exhaust valve timing and using both surfaces "d" of squat cylindrical rotor "b", a working chamber of two individual chambers "h" will produce double power or effort to that previously described. Both working chambers can operate at the same time. Thus giving four power of effort operations.

The circular seals "j", "q", and seals "l", "n", etc., can be duplicated to improve sealing efficiency.

To relieve squat cylindrical rotor "b" of any excessive bending movement, an auxiliary integral shaft "v" denoted by "chain-dot" line, can be fitted radially opposite integral shaft "e"; and could also drive rotating plate "f", inlet-exhaust valving, ignition, etc.

The squat cylindrical rotor "b" can be optionally mounted by one surface "d" to an integral shaft, the two centre-lines making an obtuse angle; when rotating giving a circular loci to adjacent edge surface "c" of squat cylindrical rotor "b". This clearance obtained will enable extra pressure seals "j" to be thereon inserted. Will necessitate sealing rotating integral shafts (not drawn).

A method of varying "Compression-Ratio" can be obtained by altering angle $\alpha°$ of rotating plate "f". This angle $\alpha°$ alteration can be applied externally, from an external source, through a modified working chamber internal spherical surface "a" (not drawn).

A method of decreasing minimum volume, with small decrease in maximum volume, can be obtained by an excresance "z" applied to outer area of surface "d" of squat cylindrical rotor "b"; or, excresance "z" applied to outer area of surface "g" of rotating plate "f". Ensuring clearances are maintained when rotating.

All valving, porting, rotating plates, etc., their positioning and sequencing is determined by position of squat cylindrical rotor "b".

Alternative methods of valving, porting; such as poppet, slide, rotary valves, masked porting,

etc., can be used to obtain conditions required for "FourStroke", "Two-Stroke", "Compression-Ignition" principles, etc. (not drawn).

For application as an "Integral engine-pump", one individual chamber can operate as an "I.C.E."; the other individual chambers as fluid, gas, vacuum pump, etc; with valving, porting, etc., to suit.

For application as a "Fluid-gas motor"; pressurised fluid, gas, can be applied to inlet positions; thus rotating squat cylindrical rotor, and rotary power obtained from integral shaft; valving, porting, etc. to suit.

For application as a "Complete fluid-gas Pump"; rotary power is applied to integral shaft; valving, porting, etc. to suit.

Claims

1. A "Spherical" rotary piston machine generating variable volumes, comprising a mainly longitudinally rotating squat cylindrical rotor with fitted pressure seals, and its integral shaft; inserted through an angular dispositioned mainly axially rotating plate (or plates), their junction geometrically relatively universally part-rotary fit pressure sealed, the rotating plates angularly dispositioned mainly axially located and pressure sealed, whilst registered rotating to internal chamber surface. The pressure seals sealing clearances between relatively moving surfaces. All housed within the interior of a ported spherical chamber forming two working chambers of two individual chambers each. Characterised in that the formation of the variable volumes results from the surface of the mainly longitudinally rotating squat cylindrical rotor cyclicly varying relatively to the surface of angularly dispositioned mainly axially rotating plate; their synchronously rotating planes and axies concentric with the mainly longitudinal axis of their ported housing spherical chamber. The number of working or effort sequences per revolution of integral shaft, being determined by selection of porting, valving, etc.

2. A spherical rotary piston machine according to Claim 1, in the form of an "Internal-Combustion-Engine", adequate valving, porting etc., to give conditions required for the "Four Stroke" cycle of "Induction-Compression-Power-Exhaust (or scavanging)". Ignition can be "Spark", or "Compression", or "Fuel-Injection" forms of ignition; or any form of controlled exploding fuel mixture.

3. A spherical rotary piston machine according to Claims 1 and 2, in the form of an "Internal-CombustionEngine". Adequate, valving, porting, etc. to give conditions required for the "Two-Stroke" cycle of "Induction-Compression/Power-Exhaust".

4. A spherical rotary piston machine, according to Claims 1, 2, 3; in the form of an "Integral Engine-Pump". Adequate valving, porting, etc. to give at least one individual chamber conditions as in Claims 2 and 3; and adequate valving, porting, etc. applied to remaining individual chambers to obtain conditions of Claim 1 for the pumping of fluids, gases, etc.

5. A spherical rotory piston machine according to Claim 1, in the form of a power-driven "Complete Pump". Adequate valving, porting, etc.; applied to each individual chamber, for the pumping of fluids, gases, vacuums, etc. "Power torque" being applied to integral shaft.

6. A spherical rotary piston machine according to Claim 1, in the form of a "Fluid or Gas Motor". Adequate valving, porting, etc., applied to each individual chamber, with pressurised gas or fluids etc., applied to inlet valving, or inlet porting etc., and "Power Torque" obtained from rotating integral shaft.

7. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, where the compression ratio within each individual chamber can be varied by altering volume or excresance attached to surfaces of rotating squat cylindrical rotor; or to surfaces of rotating plates.

8. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7; where the compression ratio within each individual chamber, can be externally controlled, and varied, by altering angular position of rotating plates.

9. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7, 8, where squat cylindrical rotor is relatively stationary and spherical chamber rotates. Adequate valving, porting, etc., being applied, and can be applied, either on, or in rotating spherical chamber and its individual chambers; or on, or in, surface of squat cylindricaly rotor; or on, or in, surfaces of oscillating "rotating" plates.

10. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7, 8, 9; where "rotating" plates are static with respect to spherical chamber, and squat cylindrical piston can axially part-rotate and can edge-loci eccentrically rotate about "integral" shaft. Adequate valving, porting, etc, being applied; and can be applied, either on, or in, spherical chamber and/or its static "rotating" plates, or on, or in, axially part-rotating eccentric edge loci squat cylindrical piston; or on or in "integral" shaft.

11. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; where the functions of valves, ports etc., can be superceded by "Masked Sliding-ports".

12. A "Spherical" rotary piston machine generating variable volumes; resulting from the mainly longitudinal rotation of an "integral" shaft and squat cylindrical rotor, inserted through angular dispositioned mained axially synchronously rotating plates, their junction relatively universally part-rotary; all housed within, and rotating concentrically with the mainly longitudinal axis of a ported spherical chamber forming individual chambers, substantially as herein described, and as illustrated in the annexed drawings.

New Claims or Amendments to Claims filed on 19 August 1980.
Superseded Claims 1 to 12

New or Amended Claims:—

1. A "Spherical" rotary piston machine generating variable volumes, comprising a mainly longitudinally rotating squat cylindrical rotor with fitted pressure seals, and its integral shaft; inserted through an angular dispositioned mainly axially rotating plate (or plates), their junction geometrically relatively universally part-rotary fit pressure sealed, the rotating plates angularly dispositioned mainly axially located and pressure sealed, whilst registered rotating to internal chamber surface. The pressure seals sealing clearances between relatively moving surfaces. All housed within the interior of a spherical chamber forming two ported working chambers of two individual chambers each. Characterised in that the formation of the variable volumes results from the surface of the mainly longitudinally rotating squat cylindrical rotor cyclicly varying relatively to the surface of angularly dispositioned mainly axially rotating plate; their synchronously rotating planes and axles mainly concentric with the mainly longitudinal axis of their housing spherical chamber. The number of working or effort sequences per revolution of integral shaft, being determined by selection of porting, valving, etc.

2. A spherical rotary piston machine according to Claim 1, in the form of an "Internal-Combustion-Engine", adequate valving, porting etc., to give conditions required for the "Four Stroke" cycle of "Induction-Compression-Power-Exhaust (or scavanging)". Ignition can be "Spark", or "Compression", or "Fuel-Injection" forms of ignition; or any form of controlled exploding fuel mixture.

3. A spherical rotary piston machine according to Claims 1, in the form of an "Internal-Combustion-Engine". Adequate, valving, porting, ignition etc. to give conditions required for the "Two-Stroke" cycle of "Induction-Compression/Power-Exhaust".

4. A spherical rotary piston machine, according to Claims 1, 2, 3; in the form of an "Integral Engine-Pump". Adequate valving, porting, etc. to give at least one individual chamber conditions as in Claims 2 or 3; and adequate valving, porting, etc. applied to remaining individual chambers to obtain conditions of Claim 1 for the pumping of fluids, gases, etc.

5. A spherical rotary piston machine according to Claim 1, in the form of a power-driven "Complete Pump". Adequate valving, porting, etc.; applied to each individual chamber, for the pumping of fluids, gases, vacuums, etc. "Power torque" being applied to integral shaft.

6. A spherical rotary piston machine according to Claim 1, in the form of a "Fluid or Gas Motor". Adequate valving, porting, etc., applied to each individual chamber, with pressurised gas or fluids etc., applied to inlet valving, or inlet porting etc., and "Power Torque" obtained from rotating integral shaft.

7. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, where the compression ratio within each individual chamber can be varied by altering volume of compression pad attached to surfaces of rotating squat cylindrical rotor; or to surfaces of rotating plates.

8. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7; where the compression ratio within each individual chamber, can be externally controlled, and varied, by altering angular position of rotating plates.

9. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7, 8, where squat cylindrical rotor is relatively stationary and spherical chamber rotates. Adequate valving, porting, etc., being applied, and can be applied, either on, or in, rotating spherical chamber and its individual chambers; or on, or in, surface of squat cylindrical rotor; or on, on in, surfaces of "oscillating" rotating plates.

10. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7, 8, 9; where rotating plates are "static" with respect to spherical chamber, and squat cylindrical piston can axially part-rotate and can edge-loci eccentrically rotate about its integral shaft. Adequate valving, porting, etc, being applied; and can be applied, either on, or in, spherical chamber and/or its "static" rotating plates, or on, or in, axially part-rotating eccentric edge loci squat cylindrical piston; or on or in integral shaft.

11. A spherical rotary piston machine according to Claims 1, 2, 3, 4, 5, 6, 7, 8, 9, 10; where the functions of valves, ports etc., can be superceded by "Masked Sliding-ports".

12. A "Spherical" rotary piston machine generating variable volumes; resulting from the mainly longitudinal rotation of an integral shaft and squat cylindrical rotor, inserted through angular dispositioned mainly axially synchronously rotating plates, their, junction relatively universally part-rotary; all housed within, and rotating mainly concentrically with the mainly longitudinal axis of a spherical chamber, forming individual chambers, substantially as herein described, and as illustrated in the annexed drawings.

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EUR-CL (EPC): F01C003/06

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ABSTRACT:

A machine that may be an I.C. engine or a pump has a spherical chamber a containing both a squat cylindrical rotor b with a shaft e and an oblique revolving plate f. The rotor and the plate are interconnected by sliding blocks k. Working-fluid ports s, r communicate with the spaces between the rotor and the plate, the volumes of these spaces varying owing to the mutual inclination of the rotation axes HL, PL of the rotor and the plate. <IMAGE>